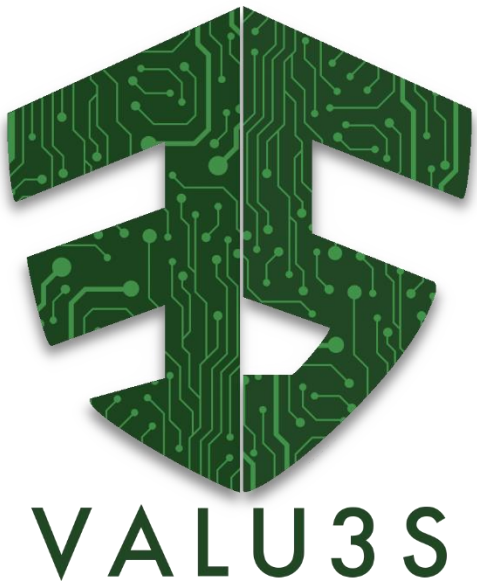

Verification and Validation of Automated Systems' Safety and Security

Updated Web-Based Repository, Linking V&V Evaluation Results to the Framework

Document Type	Report
Document Number	D5.7
Primary Author(s)	Lourenço Rodrigues (CARDIOID)
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Project Coordinator	Behrooz Sangchoolie, behrooz.sangchoolie@ri.se, RISE Research Institutes of Sweden
Project Homepage	www.valu3s.eu
JU Grant Agreement	876852

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Project Overview

Manufacturers of automated systems and the manufacturers of the components used in these systems have been allocating an enormous amount of time and effort in the past years developing and conducting research on automated systems. The effort spent has resulted in the availability of prototypes demonstrating new capabilities as well as the introduction of such systems to the market within different domains. Manufacturers of these systems need to make sure that the systems function in the intended way and according to specifications which is not a trivial task as system complexity rises dramatically the more integrated and interconnected these systems become with the addition of automated functionality and features to them.

With rising complexity, unknown emerging properties of the system may come to the surface making it necessary to conduct thorough verification and validation (V&V) of these systems. Through the V&V of automated systems, the manufacturers of these systems can ensure safe, secure and reliable systems for society to use since failures in highly automated systems can be catastrophic.

The high complexity of automated systems incurs an overhead on the V&V process making it time-consuming and costly. VALU3S aims to design, implement, and evaluate state-of-the-art V&V methods and tools in order to reduce the time and cost needed to verify and validate automated systems with respect to safety, cybersecurity and privacy (SCP) requirements. This will ensure that European manufacturers of automated systems remain competitive and that they remain world leaders. To this end, a multi-domain framework is designed and evaluated with the aim to create a clear structure around the components and elements needed to conduct V&V process through identification and classification of evaluation methods, tools, environments, and concepts that are needed to verify and validate automated systems with respect to SCP requirements.

In VALU3S, 13 use cases with specific safety, security and privacy requirements will be studied in detail. Several state-of-the-art V&V methods will be investigated and further enhanced in addition to implementing new methods aiming for reducing the time and cost needed to conduct V&V of automated systems. The V&V methods investigated are then used to design improved process workflows for V&V of automated systems. Several tools will be implemented supporting the improved processes which are evaluated by qualification and quantification of safety, security and privacy as well as other evaluation criteria using demonstrators. VALU3S will also influence the development of safety, security and privacy standards through an active participation in related standardisation groups. VALU3S will provide guidelines to the testing community including engineers and researchers on how the V&V of automated systems could be improved considering the cost, time and effort of conducting the tests.

VALU3S brings together a consortium with partners from 10 different countries, with a mix of *industrial partners* (25 partners) from automotive, agriculture, railway, healthcare, aerospace and industrial automation and robotics domains as well as leading *research institutes* (6 partners) and *universities* (10 partners) to reach the project goal.

Consortium

RISE RESEARCH INSTITUTES OF SWEDEN AB	RISE	Sweden
STAM SRL	STAM	Italy
FONDAZIONE BRUNO KESSLER	FBK	Italy
KNOWLEDGE CENTRIC SOLUTIONS SL - THE REUSE COMPANY	TRC	Spain
UNIVERSITA DEGLI STUDI DELL'AQUILA	UNIVAQ	Italy
INSTITUTO SUPERIOR DE ENGENHARIA DO PORTO	ISEP	Portugal
UNIVERSITA DEGLI STUDI DI GENOVA	UNIGE	Italy
CAMEA, spol. s r.o.	CAMEA	Czech
IKERLAN S. COOP	IKER	Spain
R G B MEDICAL DEVICES SA	RGB	Spain
UNIVERSIDADE DE COIMBRA	COIMBRA	Portugal
VYSOKE UCENI TECHNICKE V BRNE - BRNO UNIVERSITY OF TECHNOLOGY	BUT	Czech
ROBOAUTO S.R.O.	ROBO	Czech
ESKISEHIR OSMANGAZI UNIVERSITESI	ESOGU	Turkey
KUNGLIGA TEKNISKA HOEGSKOLAN	KTH	Sweden
STATENS VAG- OCH TRANSPORTFORSKNINGSINSTITUT	VTI	Sweden
UNIVERSIDAD DE CASTILLA - LA MANCHA	UCLM	Spain
FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.	FRAUNHOFER	Germany
SIEMENS AKTIENGESELLSCHAFT OESTERREICH	SIEMENS	Austria
RULEX INNOVATION LABS SRL	RULEX	Italy
NXP SEMICONDUCTORS GERMANY GMBH	NXP-DE	Germany
PUMACY TECHNOLOGIES AG	PUMACY	Germany
UNITED TECHNOLOGIES RESEARCH CENTRE IRELAND, LIMITED	UTRCI	Ireland
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ERGUNLER INSAAT PETROL URUNLERI OTOMOTIV TEKSTIL MADENCILIK SU URUNLER SANAYI VE TICARET LIMITED STI.	ERARGE	Turkey
OTOKAR OTOMOTIV VE SAVUNMA SANAYI AS - OTOKAR AS	OTOKAR	Turkey
TECHY BILISIM TEKNOLOJILERI DANISMANLIK SANAYI VE TICARET LIMITED SIRKETI - TECHY INFORMATION TECHNOLOGIESAND CONSULTANCY LIMITED COMPANY	TECHY	Turkey
ELECTROTECNICA ALAVESA SL	ALDAKIN	Spain
INTECS SOLUTIONS SPA	INTECS	Italy
LIEBERLIEBER SOFTWARE GMBH	LLSG	Austria
AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH	AIT	Austria
E.S.T.E. SRL	ESTE	Italy
NXP SEMICONDUCTORS FRANCE SAS	NXP-FR	France
BOMBARDIER TRANSPORTATION SWEDEN AB	BT	Sweden
QRTECH AKTIEBOLAG	QRTECH	Sweden
CAF SIGNALLING S.L	CAF	Spain
MONDRAGON GOI ESKOLA POLITEKNIKOA JOSE MARIA ARIZMENDIARRIETA S COOP	MGEP	Spain
INFOTIV AB	INFOTIV	Sweden
BERGE CONSULTING AB	BERGE	Sweden
CARDIOID TECHNOLOGIES LDA	CARDIOID	Portugal

Executive Summary

This deliverable describes the work developed to upload the demonstrator results to the VALU3S web-based repository. It describes the new data-types defined under WP2 to store demonstrator information and their evaluation results, the workflow designed for partners to upload their contributions, and a summary of items created during this action.

Prior to the efforts reported in this document, continuous work has been made to populate the web-based repository with the information that constitutes the multi-layered framework proposed in this project. On that account, this deliverable relies on the developments reported in previous deliverables, namely:

- *D2.5 – Initial updated web-based repository, linking use cases (scenarios, requirements specifications) and test cases to the framework* [1],
- *D2.6 - Final updated web-based repository, linking use cases (scenarios, requirements specifications) and test cases to the framework* [2],
- *D3.2 - Updated web-based repository, linking state-of-the-art V&V Methods to use cases and scenarios* [3],
- *D3.7 - Updated web-based repository, linking newly developed V&V Methods to use cases and scenarios* [4], *and*
- *D4.12 - Updated Web-based Repository, Linking V&V Tools to the Framework* [5].

The demonstrator information is based on the inputs provided by partners on another WP5 deliverable: D5.5 - *Final Demonstrator Implementation Status Report* [6], which describes in detail the demonstrators implemented in each use case and contextualizes them within the use cases' V&V challenges and evaluation framework.

Furthermore, the concrete results stored in the repository are extracted from deliverable D5.6 – *Evaluation report including the evaluation of the improved V&V processes as well as framework limitations* [7]. This deliverable describes quantitative, qualitative, and impact results. The quantitative results correspond to the improvement measurements made to evaluate the benefits of implementing the V&V methods and tools developed in VALU3S, and these are the ones uploaded to the web-based repository. Qualitative results measure the perceived usefulness of developed V&V workflows and demonstrators through questionnaires, and the impact results estimate the broader consequences of the attained results for industry domains, economy, and society.

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Revision History

Version	Date	Author (Affiliation)	Comment
0.1	2022-09-19	Lourenço Rodrigues (CARDIOID)	Initial Draft Version
1.0	2023-05-19	Lourenço Rodrigues (CARDIOID)	First version ready for review
1.1	2023-05-24	Lourenço Rodrigues (CARDIOID)	Update after first round of review
1.2	2023-05-25	Behrooz Sangchoolie (RISE)	Reviewing the first final draft of the report, making minor formatting changes, and leaving additional comments to be addressed.
1.3	2023-05-25	Lourenço Rodrigues (CARDIOID)	Update addressing remaining comments.
1.4	2023-05-26	Behrooz Sangchoolie (RISE)	Reviewing the second final draft of the report, making minor formatting changes.
1.5	2023-05-26	Behrooz Sangchoolie (RISE)	Final version of the report to be submitted.

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Acronyms

KPI	Key Performance Indicator
SCP	Safety, Cybersecurity, and Privacy
V&V	Verification and Validation
WP	Work Package
QAM	Quality Acceptance Model

Chapter 1. Introduction

The main objective of the VALU3S project is to lower the effort and cost of engineering processes by focusing on one (or more) of the most resource-consuming steps of the product life cycle – verification and validation (V&V). V&V is not just a single engineering phase, but a complex process integrated into different engineering phases, and is applied with different levels of detail depending upon the development stage. It begins before even a single line of code is produced and does not end after a product is deployed to the market, as unit validation and new versions' verification will continue to be performed. The VALU3S project aims at developing new and improving existing V&V methods for V&V of automated systems, which require special approaches in providing confirmation of services and warranties which are different from the traditional techniques. Within the project, a V&V framework has been developed, which integrates newly proposed and/or improved versions of already existing V&V methods and tools supporting these methods. The framework has been applied in the development phase of products in different domains (agriculture, aerospace, automotive, healthcare, industrial robotics, and railway) to show the improvements gained by the framework. The V&V process has been improved not just by reducing the effort and cost but also by increasing the quality of products while reducing the time needed for V&V. This main result has been demonstrated by providing an evaluation report for all use cases and by demonstrating the utilization of newly developed methods and tools in these use cases. All the methods developed and improved are documented in a web-based repository [8].

This deliverable reports on the efforts developed to upload the demonstrator evaluation results obtained by partners within each use case to the web-based repository. These results and the methodologies applied to produce them are detailed in another deliverable from WP5, D5.6 – *Evaluation report including the evaluation of the improved V&V processes as well as framework limitations* [7]. The results uploaded to the web-based repository focus specifically on what was defined in D5.6 as quantitative and qualitative results. The former corresponds to the measurable improvements driven by the development of V&V tools, methods, and workflows within the VALU3S project and the latter to the perceived usefulness of developed V&V workflows in each use case.

To store these quantitative results, three new (relative to the repository status described in D4.12 [5]) data-types were defined: Demonstrator Evaluation Result, Measurement of V&V Process Improvement, and Measurement of SCP V&V Improvement. The first contains the context under which a set of measurements were obtained. The other two are specific measurement types, possessing the same structure, but separating the concepts described in other WP5 deliverables as V&V evaluation and SCP evaluation.

This document contains descriptions of the data-types created as well as the upload workflow used by consortium partners to share their results in Chapter 2. A list of uploaded results is presented in Chapter 3. At last, Chapter 4 contains the conclusion and remarks regarding the results upload process.

Chapter 2. Hosting Demonstrators and Evaluation Results on the Web-based Repository

2.1 Newly Defined Data-types

To allow the web-based repository to host the demonstrator and results information, three new data-types were defined. The next subsections describe those data-types and the fields that they support.

2.1.1 Demonstrator Evaluation Result

Demonstrator Evaluation Result provides a description of demonstrators created by each use case, that are originally described in D5.5 [6] and lists the various V&V and SCP that are associated with each use case. The data-type contains the following fields presented in Table 2-1.

Table 2-1 Fields present in "Demonstrator Evaluation Results" data-type.

Field Name	Type	Description
ID	String	Unique identifier of demonstrator.
Short description	Text	Description of demonstrator purpose and implementation overview.
Responsible Contacts	Link	List of "Organization" instances on the repository that are responsible for the demonstrator.
Use Case	Choice<String>	Associated use case.
TRL	Number (1-9)	Technology Readiness Level of the demonstrator.
Transferability	Number (1-5)	5-point scale of transferability level (1=Very bad; 5=Very good).
Transferability Comment	Text	Further information about transferability evaluation.
Link to Use Case	Link	Link to Use Case instance on the repository.
Measurement of SCP improvement	Link	List of links to "Measurement of SCP Improvement" instances on the repository associated with this demonstrator.
Measurement of V&V process improvement	Link	List of links to "Measurement of V&V Process Improvement" instances on the repository associated with this demonstrator.
Qualitative Results	Rich Text	Rich text field capable of presenting an image that represents the Qualitative Results of that demonstrator.

2.1.2 Measurement of V&V Process Improvement

This data-type provides concrete measurements of V&V process-related evaluation and also links these measurements with the use case test cases, requirements, and evaluation scenarios, as well as involved V&V methods and tools. A description field also allows the contextualization of measurement methodologies used. It contains the fields presented in Table 2-2.

Table 2-2 Fields present in "Measurement of SCP V&V improvement" and "Measurement of V&V process improvement", both data-types are very similar, differing on the specific criteria that they support.

Field Name	Type	Description
Description	Text	Description of measurement methodology and context.
UC ID	Choice<String>	Associated Use Case.
Test Cases	Link	List of "Test Case" instances on the repository that this measurement covers.
Requirements	Link	List of "Requirement" instances on the repository that this measurement covers.
Evaluation Scenarios	Link	List of "Evaluation Scenario" instances on the repository that this measurement covers.
V&V Methods	Link	List of "Method" instances on the repository that this measurement uses.
V&V Tools	Link	List of "Tool" instances on the repository that this measurement uses.
Eval_criteria	Choice<String>	Evaluation criteria used in this measurement.
Quantitative results	Text	Description of the formulas used to compute the criteria's value.
Long description	Text	Detailed description of how the criteria value was obtained, including the setup of various tests performed to obtain it.

2.1.3 Measurement of SCP V&V Improvement

This data-type provides concrete measurements of SCP-related evaluation and also links these measurements with the use case test cases, requirements, and evaluation scenarios, as well as involved V&V methods and tools. A description field also allows the contextualization of measurement methodologies used. The data structure of this data-type is identical to the Measurement of V&V Process Improvement, with the only difference being the set of evaluation criteria each can represent.

2.2 Upload Instructions

To successfully upload a set of results, partners had to follow this set of instructions:

1. Login into the VALU3S web-based repository and select "Demonstrator Evaluation Results" on the "Use Cases" dropdown menu (see Figure 2-1):

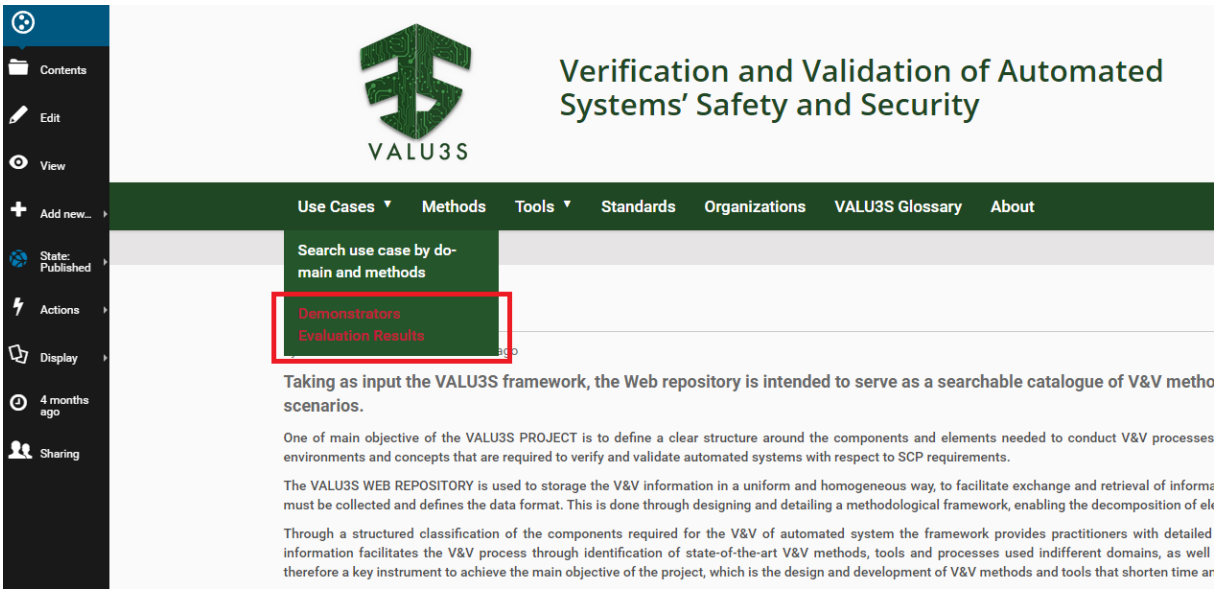


Figure 2-1 Where to find the Demonstrators Results tab.

2. Select "add new" > "Demonstrator Evaluation Result" (see Figure 2-2):

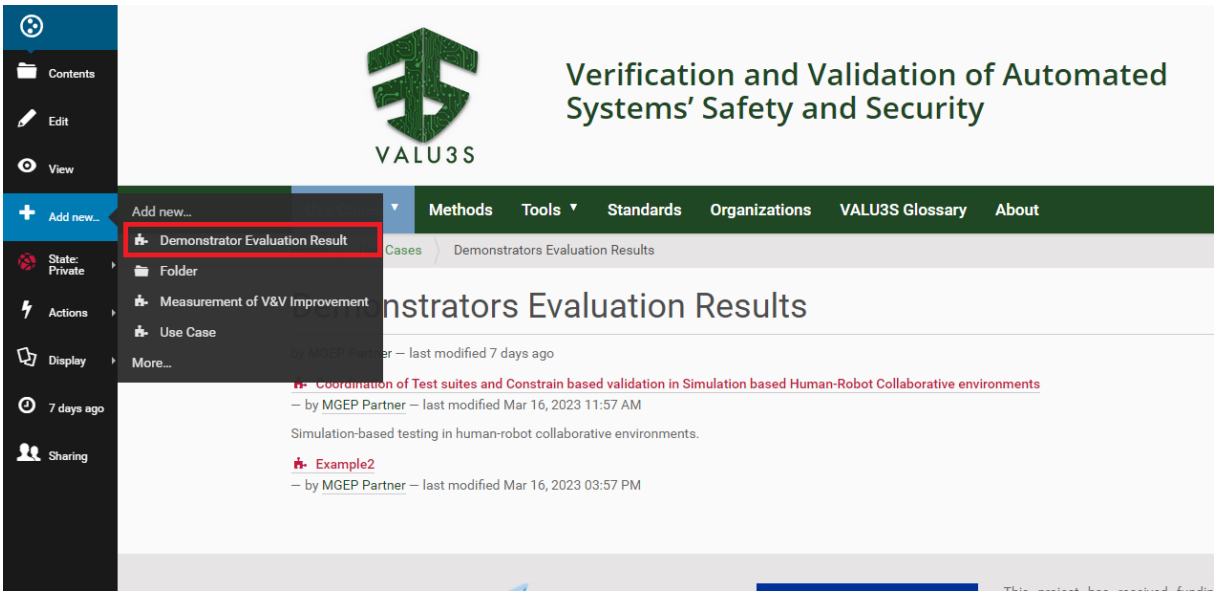


Figure 2-2 Create a new "Demonstrator Evaluation Result" item.

3. Fill all information fields **except for the links** and save (see Figure 2-3).

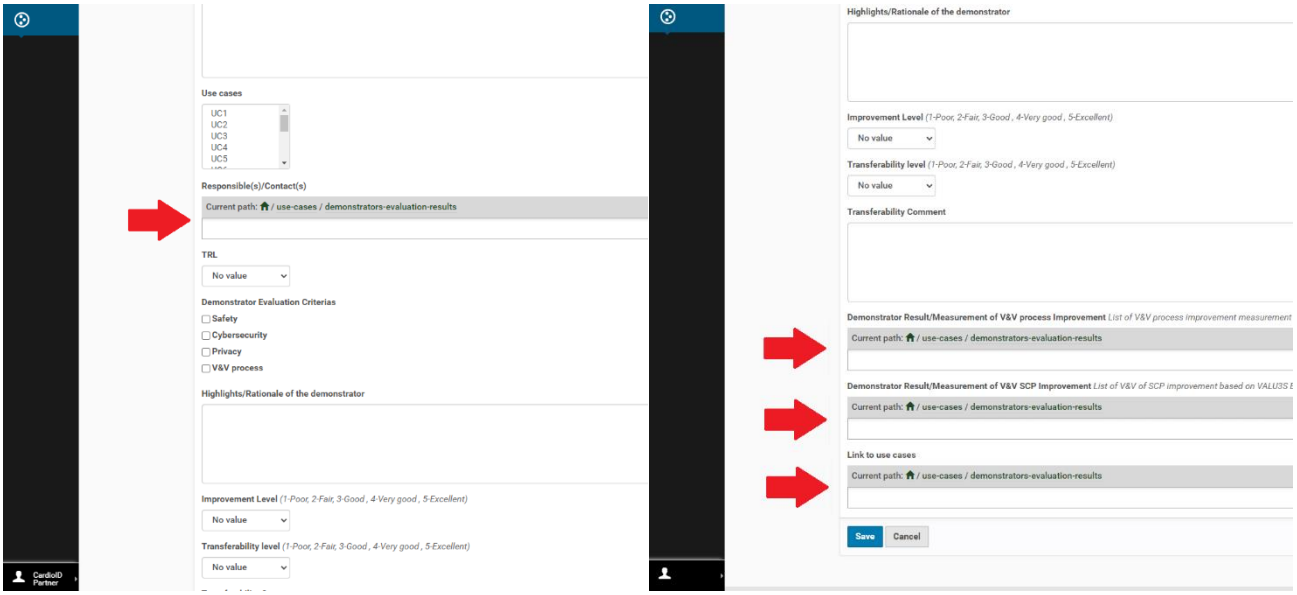


Figure 2-3 Link type fields that should not be filled yet.

4. Inside the newly created "Demonstrator Evaluation Result" select "add new" > "Measurement of SCP V&V improvement" (see Figure 2-4):

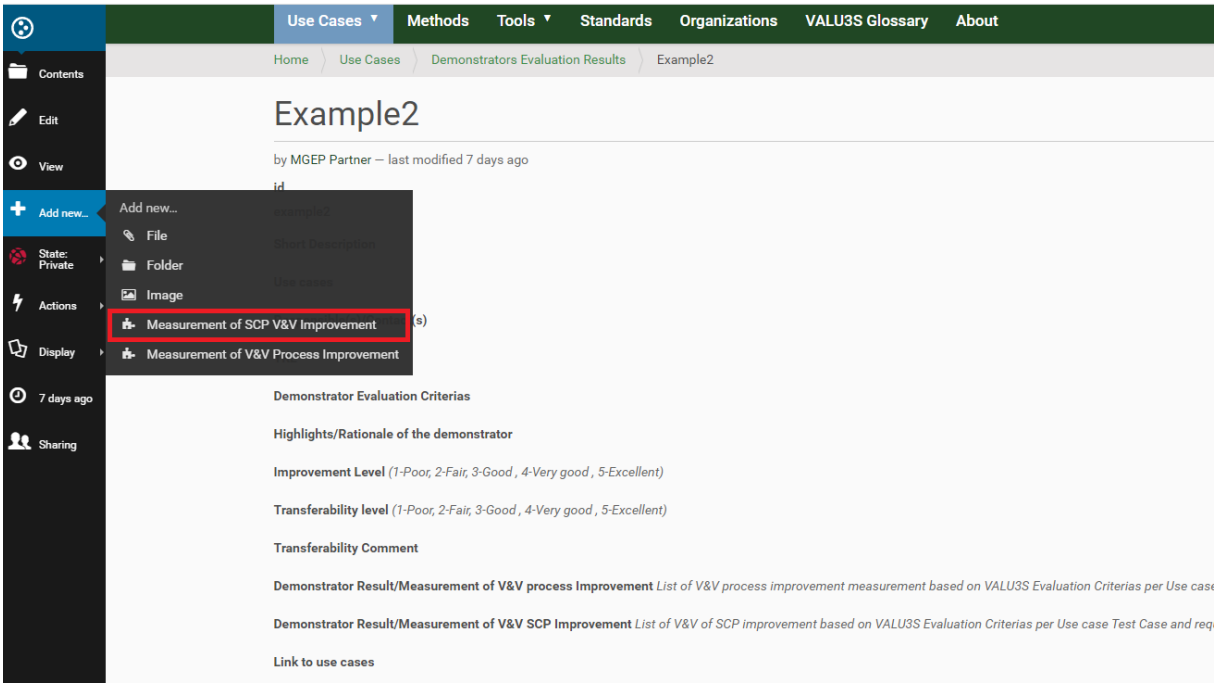


Figure 2-4 Create a new "Measurement of SCP V&V improvement" item.

5. Fill all information fields **except for the links** and save (base information on internal consortium documentation used to track partners' progress) (see Figure 2-5).

Figure 2-5 Link type fields that should not be filled yet.

6. Inside the newly created "Measurement of SCP V&V improvement" select "Edit" and add the links (those marked in Figure 2-5).
7. Repeat steps 4 to 6 for all SCP evaluation results associated with the demonstrator.
8. Inside the created "Demonstrator Evaluation Result" select "add new" > " Measurement of SCP V&V improvement" (see Figure 2-6).

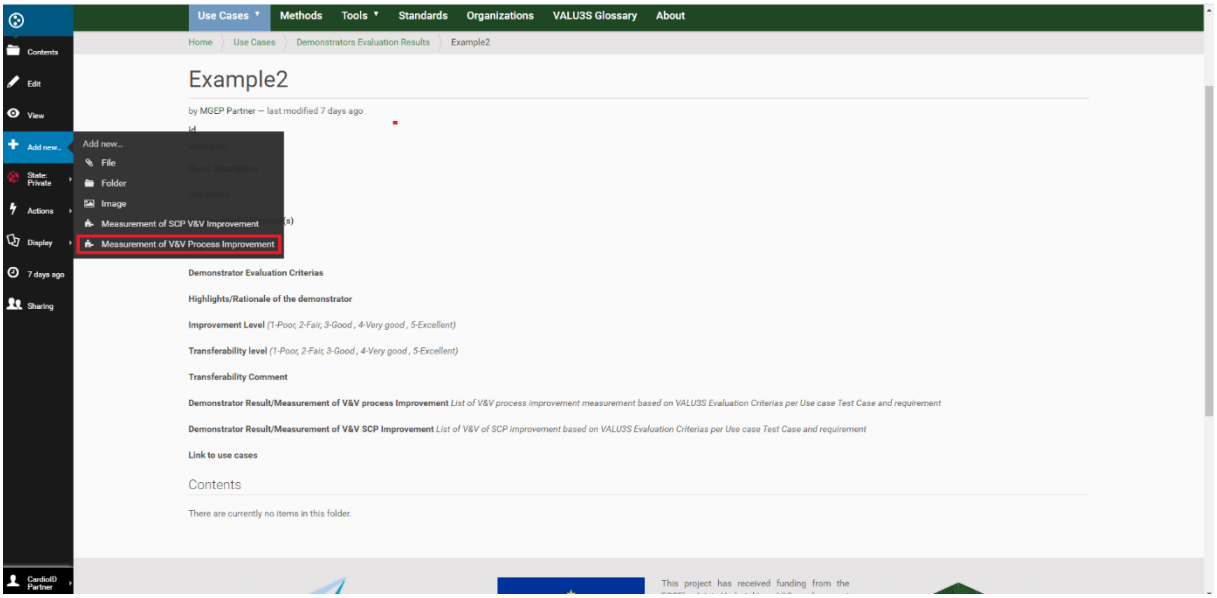


Figure 2-6 Create new "Measurement of V&V process improvement" item.

9. Repeat steps 4 to 6 for all V&V evaluation results associated with the demonstrator.
10. Inside the created "Demonstrator Evaluation Result" select "Edit" and add the links to the Use Case, Responsible contacts, Measurement of V&V process improvements, and Measurement of SCP V&V improvements (those marked in Figure 2-3).

2.3 Qualitative Data Upload

Qualitative data was obtained in D5.6 [7] through the analysis of questionnaires that measured Demonstrator acceptance through the Quality Acceptance Model (QAM). Given the highly structured nature of these results, they were compiled into an image showing the relations between QAM features. The images were built from data present in the qualitative evaluation of each of the demonstrators present in D5.6 and uploaded to the corresponding demonstrator page. An example of a complete Demonstrator page, containing all the information described in this chapter, is presented in Figure 2-8, showing the rendering of the demonstrator information, the links to its results, contributing organizations and use case, and the diagram presenting QAM results.

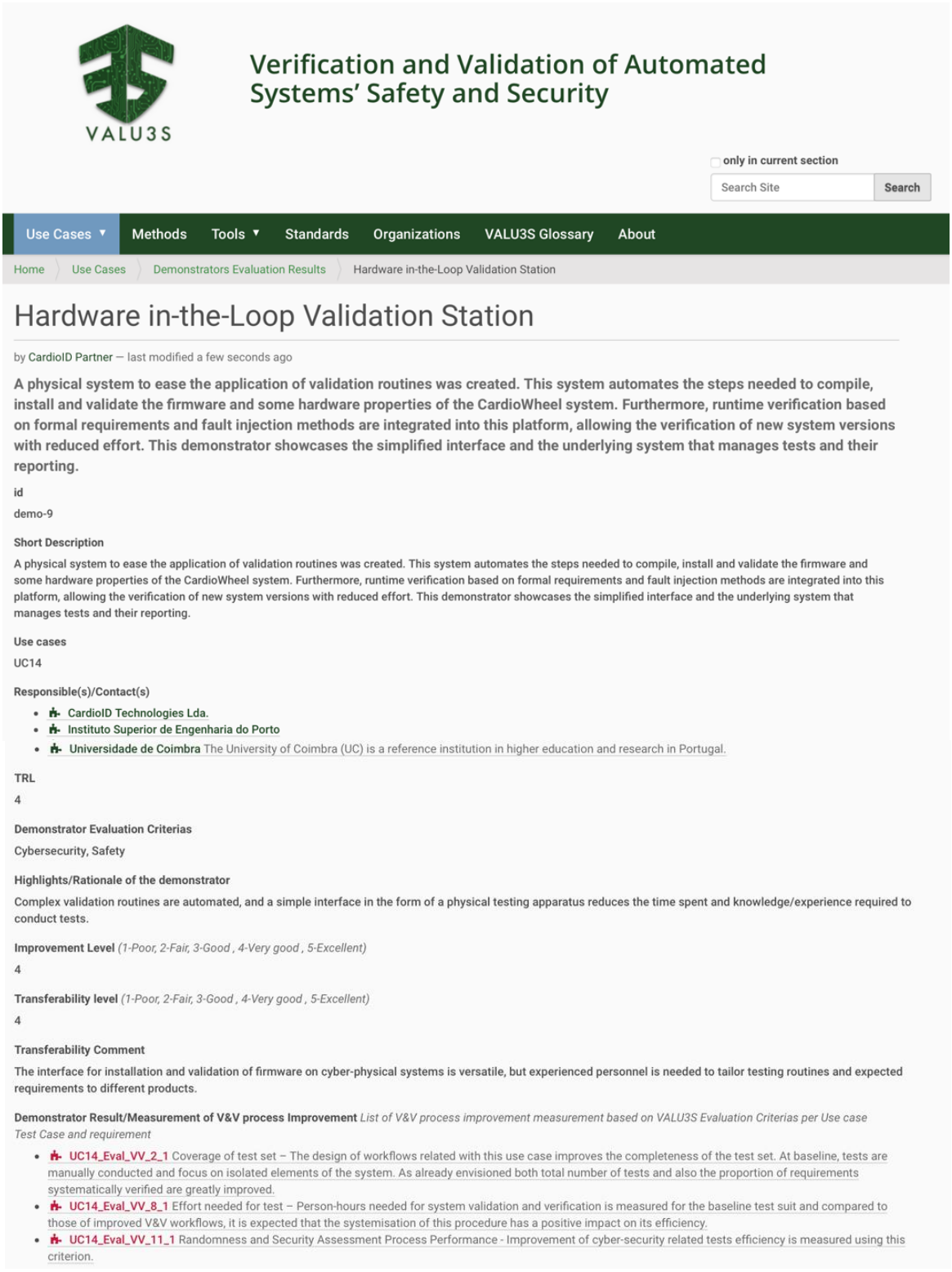


Figure 2-7 Example of complete Demonstrator page (part 1/2)

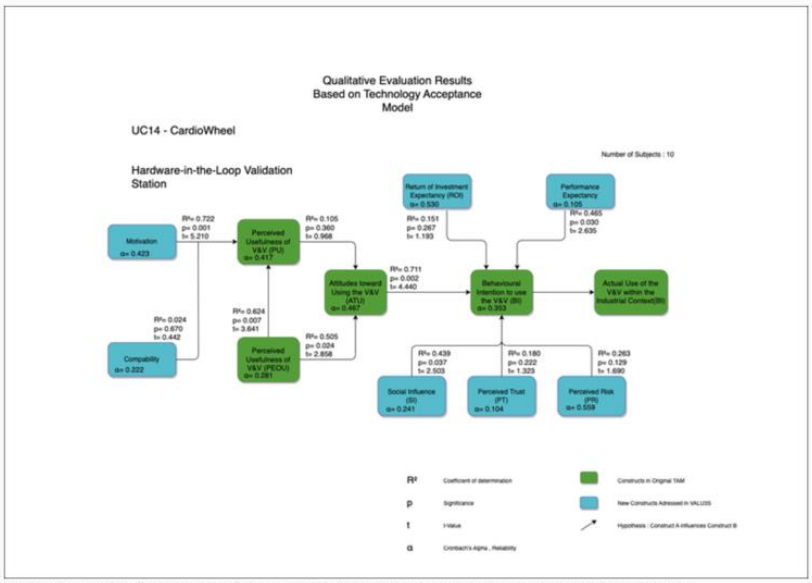
Demonstrator Result/Measurement of V&V SCP Improvement *List of V&V of SCP improvement based on VALU3S Evaluation Criterias per Use case Test Case and requirement*

- UC14_Eval_SCP_1_1 By injecting faults and attacks to evaluate CardioWheel's system capacity to cope with incorrect, invalid, or untrusted data, this error coverage is used to evaluate the system responses to those tests.
- UC14_Eval_SCP_2_1 The number of Safety/Security Requirement Violations - CARDIOID uses this criterion to evaluate results from runtime verification tests. Part of these tests deal with altered data and attempts to inject attacks that could, in an unsafe system, expose personal data from users. Because of that, good evaluation scores on these metrics point to a safe system privacy-wise.
- UC14_Eval_SCP_2_2 – Number of Safety/Security Requirement Violations - CARDIOID uses this criterion to evaluate results from runtime verification tests. Part of these tests deal with altered data and attempts to inject attacks that could, in an unsafe system, expose personal data from users. Because of that, good evaluation scores on these metrics point to a safe system privacy-wise.
- UC14_Eval_SCP_2_2 – Number of Safety/Security Requirement Violations - CARDIOID uses this criterion to evaluate results from runtime verification tests. Part of these tests deal with altered data and attempts to inject attacks that could, in an unsafe system, expose personal data from users. Because of that, good evaluation scores on this metrics point to a safe system privacy-wise.
- UC14_Eval_SCP_2_3 Number of Safety/Security Requirement Violations - CARDIOID uses this criterion to evaluate results from runtime verification tests. Part of these tests deal with altered data and attempts to inject attacks that could, in an unsafe system, expose personal data from users. Because of that, good evaluation scores on this metrics point to a safe system privacy-wise.
- UC14_Eval_SCP_2_4 Number of Safety/Security Requirement Violations - CARDIOID uses this criterion to evaluate results from runtime verification tests. Part of these tests deal with altered data and attempts to inject attacks that could, in an unsafe system, expose personal data from users. Because of that, good evaluation scores on this metrics point to a safe system privacy-wise.
- UC14_Eval_SCP_9_1 Randomness and cryptographic algorithm strength - the different metrics of this evaluation criteria is used to measure the adequacy of cryptographic algorithms implemented in this system.

Link to use cases

- **UC14 - CardioWheel** CardioWheel is an Advanced Driver Assistance System that acquires ECG (electrocardiogram) from the driver's hands to continuously detect drowsiness, cardiac health problems, and perform biometric identity recognition.

Qualitative Results



Qualitative Results of Hardware-in-the-Loop Validation Station demonstrator, as measured through QAM.

Contents

Multimedia
– by CardioID Partner – last modified May 18, 2023 11:26 AM

Results
– by CardioID Partner – last modified May 11, 2023 05:09 PM

Evaluation results linked to this demonstrator

Figure 2-8 Example of complete Demonstrator page (part 2/2)

Chapter 3. Evaluation Results Added to the Web-Based Repository

3.1 Demonstrator Evaluation Results

The demonstrators uploaded to the Web-based repository are listed in Table 3-1, in which all 21 Lead demonstrators are present, as well as five other complementary demonstrators produced by partners.

Table 3-1 List of uploaded Demonstrators

#Demo	Demonstrator Name	Related Use Case	Type	Link
1	V&V of an automated robot inspection cell for automotive body-in-white	UC11	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/v-v-of-an-automated-robot-inspection-cell-for-automotive-body-in-white
2	Remote controlled radar target simulation and validation	UC3	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/2
3	Validation of Computer Vision system for railway using synthetic data	UC9	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/validation-of-computer-vision-system-for-railway-using-synthetic-data200b
4	Coordination of Test suites and Constrain based validation in Simulation based Human-Robot Collaborative environments	UC7	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-5
5	Infusion Controller of NMT	UC8	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/infusion-controller-of-nmt
6	Mu-FRET	UC5	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-6
7	Verification and Validation of Car Teleoperation application under Faults and Attacks in Wireless Communication Channel (New)	UC2	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-7

#Demo	Demonstrator Name	Related Use Case	Type	Link
8	V&V of Vehicle LP Detection System Using Traffic Simulator	UC1	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-08
9	Hardware in-the-Loop Validation Station	UC14	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-9
10	Instrumented Driving Simulator for Drowsiness Data Generation	UC14	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-10
11	Real-Time Analogue Signal Monitoring (RTAMT) for a Digital Twin for Motion Control	UC13	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-11
12	Early V&V in Knowledge Centric Systems Engineering	UC8	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-12
13	Safety verification and validation for the signalling railway application	UC10	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/safety-verification-and-validation-for-the-signalling-railway-application
14	MSA-FLA with CHESS-FLA	UC6/UC8	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-14
15	Arm Unity	UC6	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-15
16	Model based Design and Validation of the hybrid Model	UC5	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/model-based-design-and-validation-of-the-hybrid-model
17	Pre-injection analysis for model-implemented fault- and attack injection	UC5	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-17
18	Handling and Gripping of Products / Parts	UC4	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-18
19	ML-Pipeline	UC4	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-19
20	Testing Network Communication using NetLoiter	UC1/UC2	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-20
21	SimuLation-based Verification (SiLVer) workflow and tool (new)	UC5	Lead	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-21-silver

#Demo	Demonstrator Name	Related Use Case	Type	Link
22	Otokar Simulation Tool	UC11	Complementary	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-4
23	Performing safety trajectory planning tests with a combination of SRVT and IM-FIT	UC11	Complementary	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/performing-safety-trajectory-planning-tests-with-a-combination-of-srvt-and-imfit
24	Demonstration of faults/attacks detection with Data-driven Fault Detector	UC6	Complementary	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demonstration-of-faults-attacks-detection-with-data-driven-fault-detector
25	IEEE 802.15.4 wireless sensor network – Intrusion Detection	UC6	Complementary	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/ieee-802-15-4-wireless-sensor-network-2013-intrusion-detection
26	RAMSES tool for Risk Management of Agriculture Robot	UC6	Complementary	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/ramses-tool-for-risk-management-of-agriculture-robot/view

3.2 SCP Evaluation Results

For each of the demonstrators presented in Table 3-1, several SCP criteria related results were created in the web-based repository. Table 3-2 lists these results and the links to where they are located within the web-based repository.

Table 3-2 "Measurement of SCP V&V improvement" uploaded to the web-based repository.

Result Name	#Demo	Link
UC7 Mapping2-88 Eval_SCP_2	4	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-5/uc7-mapping2-88-eval_scp_2
UC14_Eval_SCP_1_1	9	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-9/results/uc14_eval_1_1
UC14_Eval_SCP_2_1	9	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-9/results/uc14_eval_scp_2_1
UC14_Eval_SCP_2_2	9	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-9/results/uc14_eval_scp_2_2
UC14_Eval_SCP_2_3	9	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-9/results/uc14_eval_scp_2_3
UC14_Eval_SCP_2_4	9	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-9/results/uc14_eval_2_4
UC14_Eval_SCP_9_1	9	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-9/results/uc14_eval_scp_9_1
UC8 Mapping-3-29 SCP5	14	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-14/uc8-mapping-3-29

Result Name	#Demo	Link
UC8 Mapping-3-29 SCP12	14	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-14/copy_of_uc8-mapping-3-29
UC8 Mapping-3-30 SCP12	14	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-14/copy2_of_uc8-mapping-3-29
UC8 Mapping-3-30 SCP5	14	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-14/copy3_of_uc8-mapping-3-29
UC8 Mapping-3-31 SCP5	14	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-14/copy4_of_uc8-mapping-3-29
UC8 Mapping-3-31 SCP12	14	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-14/copy5_of_uc8-mapping-3-29
UC8 Mapping-3-49 SCP12	14	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-14/copy6_of_uc8-mapping-3-29
UC8 Mapping-3-49 SCP5	14	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-14/copy7_of_uc8-mapping-3-29
UC6 Mapping-3-50 SCP5	14	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-14/copy8_of_uc8-mapping-3-29
UC6 Mapping-3-50 SCP12	14	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-14/copy9_of_uc8-mapping-3-29
UC6 Mapping-3-51 SCP5	14	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-14/copy10_of_uc8-mapping-3-29
Support for coverage of safety/security requirement violations	11	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-11/support-for-coverage-of-safety-security-requirement-violations
Eval_SCP_2 – Number of Safety/Security Requirement Violations	3	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/validation-of-computer-vision-system-for-railway-using-synthetic-data200b/eval_scp_2-2013-number-of-safety-security-requirement-violations
Eval_SCP_4 – Metrics to Evaluate AI/ML Algorithms	3	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/validation-of-computer-vision-system-for-railway-using-synthetic-data200b/eval_scp_4-2013-metrics-to-evaluate-ai-ml-algorithms
UC14_Eval_SCP_2_5	10	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-10/results/uc14_eval_scp_2_5
UC14_Eval_SCP_4_1	10	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-10/results/uc14_eval_scp_4_1
UC14_Eval_SCP_4_2	10	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-10/results/uc14_eval_scp_4_2
Eval_SCP_1 – Error coverage	17	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-17/eval_scp_1-2013-error-coverage

Result Name	#Demo	Link
UC10_SCP_10	13	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/safety-verification-and-validation-for-the-signalling-railway-application/uc10_scp_10
UC1_Eval_SCP_4_1	8	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-08/uc1_eval_scp_4_1
UC1_Eval_SCP_15_1	8	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-08/uc1_eval_scp_15_1
UC1_Eval_SCP_16_1	8	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-08/uc1_eval_scp_16_1
UC1_Eval_SCP_17_1	8	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-08/uc1_eval_scp_17_1
UC2_Eval_SCP_1	7	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-7/results/uc2_eval_scp_1
UC2_Eval_SCP_5	7	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-7/results/uc2_eval_scp_2
UC6 Mapping-3-155 SCP3	25	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/ieee-802-15-4-wireless-sensor-network-2013-intrusion-detection/uc6-mapping-3-155-scp3
UC8_Eval_SCP_2_1	12	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-12/uc8_eval_scp_2_1
UC8_Eval_SCP_7_1	12	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-12/uc8_eval_scp_7_1
UC8_Eval_SCP_2_2	12	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-12/uc8_eval_scp_2_2
UC8_Eval_SCP_7_2	12	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-12/uc8_eval_scp_7_2
UC1_UC2_Eval_SCP_2	20	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-20/results/uc2_eval_vv_6_1
UC5 Eval Criteria SCP-2 Mapping 1-4	6	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-6/uc5-mapping-1-4
UC5 Eval Criteria SCP-2 Mapping 1-3	6	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-6/uc5-eval-criteria-scp-2-mapping-1-3
UC5_Eval_SCP_1_SiLVer	21	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-21-silver/uc5_eval_scp_silver
UC5_Eval_SCP_3_SiLVer	21	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-21-silver/uc5_eval_scp_3_silver
UC5_Eval_SCP_10_SiLVer	21	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-21-silver/uc5_eval_scp_10_silver
UC5_Eval_SCP_11_SiLVer	21	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-21-silver/uc5_eval_scp_11_silver

3.3 V&V Evaluation Results

Several V&V process improvements were also linked to the demonstrators as results, which are presented in Table 3-3.

Table 3-3 "Measurement of V&V process improvement" uploaded to the web-based repository.

Result Name	#Demo	Link
UC7 Mapping2-89 Eval_VV_8	4	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-5/uc7-mapping2-89-eval_vv_8
UC14_Eval_VV_2_1	9	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-9/results/uc14_eval_vv_2_1
UC14_Eval_VV_8_1	9	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-9/results/uc14_eval_vv_8_1
UC14_Eval_VV_11_1	9	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-9/results/uc14_eval_vv_11_1
UC8 Mapping-3-48 V&V10	14	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-14/uc8-mapping-3-48-v-v10
Eval_VV_3 – Number of Test Cases	3	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/validation-of-computer-vision-system-for-railway-using-synthetic-data200b/eval_vv_3-2013-number-of-test-cases
Eval_VV_8 – Effort Needed for Test	3	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/validation-of-computer-vision-system-for-railway-using-synthetic-data200b/eval_vv_8-2013-effort-needed-for-test
Eval_VV_3 - Number of test cases	17	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-17/eval_vv_3-number-of-test-cases
Eval_VV_1 – Time of test execution	17	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-17/eval_vv_1-2013-time-of-test-execution
Eval_VV_5 – Joint Management of SCP Requirements	17	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-17/eval_vv_5-2013-joint-management-of-scp-requirements
UC10_V&V_10	13	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/safety-verification-and-validation-for-the-signalling-railway-application/uc10_v-v_10
UC2_Eval_VV_2	7	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-7/results/uc2_eval_vv_2
UC2_Eval_VV_8	7	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-7/results/uc2_eval_vv_8
UC8_Eval_VV_5_1	12	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-12/uc8_eval_vv_5_1
UC8_Eval_VV_10_1	12	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-12/uc8_eval_vv_10_1
UC8_Eval_VV_5_2	12	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-12/uc8_eval_vv_5_2
UC8_Eval_VV_10_2	12	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-12/uc8_eval_vv_10_2

Result Name	#Demo	Link
UC2_Eval_VV_6_1	20	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-20/results/copy_of_uc2_eval_vv_6_1
UC2_Eval_VV_2	20	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-20/results/uc2_eval_vv_2
UC1_Eval_VV_9	20	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-20/results/uc1_eval_vv_9
UC6_Mapping2-19_Mapping2-20_EvalCriteria_VV_8	15	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-15/uc6-mapping2-19-evalcriteria_vv_8
UC5_Eval_VV_1_SiLVer	21	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-21-silver/uc5_eval_vv_silver
UC5_Eval_VV_3_SiLVer	21	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-21-silver/uc5_eval_vv_3_silver
UC5_Eval_VV_8_SiLVer	21	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-21-silver/uc5_eval_vv_8_silver
UC5_Eval_VV_10_SiLVer	21	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/demo-21-silver/uc5_eval_vv_10_silver
EvalCriteriaV&V_12	26	https://repo.valu3s.eu/use-cases/demonstrators-evaluation-results-1/ramses-tool-for-risk-management-of-agriculture-robot/evalcriteriav-v_12

Chapter 4. Conclusion

The efforts conducted during this deliverable preparation resulted in the successful uploading of 26 demonstrators, 44 SCP-, and 25 VV-related results to the web-based repository. The presence of such information provides repository visitors with examples of application of the various V&V methods and tools collected and improved during the VALU3S Project, inserted in real V&V workflows in different domains.

The publication of achieved results promotes the use case providers' product development and offers measurable indicators that justify the employment of V&V tools by organizations outside of the VALU3S consortium, increasing visibility and potential deals for tool providers too.

The coordination between WP2 and WP5 was essential to the success of this uploading effort. With WP2 preparing the web-based repository update to accommodate the uploaded information, and WP5 providing the guidelines and tracking systems that made this uploading effort organized and easy to repeat. The upload procedure will allow partners to upload all results they obtain up until the end of the project.

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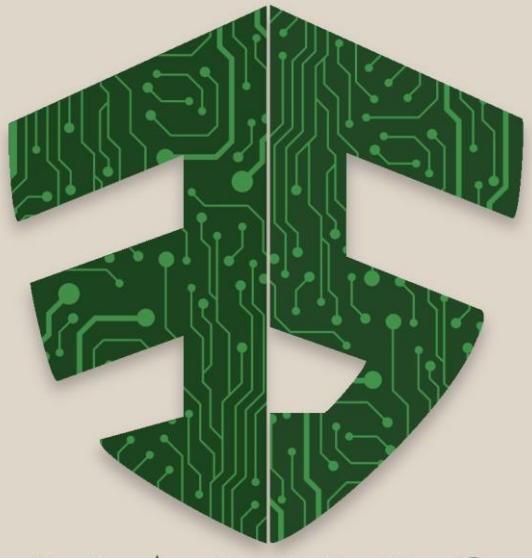

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